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ORIGINAL ARTICLE

Technical Quality Assessment of Root Canal Treatment on Endodontic Typodonts Performed by Pre-Clinical Students at Fatima Jinnah Dental College

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ABSTRACT

Background: Students at pre clinical level at Fatima Jinnah Dental College are taught root canal treatment on endodontic typodonts. Technical quality of the root canal treatments performed by these students was assessed to determine success of teaching methodology and reinforcement of tooth morphology concepts.
Methodology: In this cross-sectional study, obturation quality of 20 anterior and 30 posterior endodontic typodonts were evaluated on the parameters of length, density and taper. The collected data was evaluated using SPSS software, version 20.0. Chi square analysis was applied to compare the quality of root canal obturation between types of tooth. Kappa statistics was used for inter examiner reliability.
Results: After assessing the three variables, adequate length control was observed in (92.9%), while 7.1% of under filling was seen in both groups. Percentage of teeth showed homogeneity in obturation density that is 30%, 60% teeth showed acceptable, whereas 10% showed unacceptable obturation homogeneity. 55.6% teeth showed perfect obturation taper and 4% showed acceptable.
Conclusion: The obtained results showed root canal treatment quality done by Fatima Jinnah Dental College undergraduate dental students to be adequate on anterior endodontic typodont teeth as compared to posterior endodontic teeth. This will guide us in utilizing further demonstration hours and more practice time on posterior endodontic teeth. Our study also displayed the need of incorporating hands on practice of root canal treatments on extracted teeth before students are allowed to work on patients.
Keywords: Root Canal Treatment, Endodontic Typodont, Obturation, Preclinical.

INTRODUCTION

Root canal treatment is a clinical procedure for pain relief and restoration of tooth function, resulting in increased life span of natural dentition [1]. The technical quality of root canal treatment (RCT) has an influence on its result, and accordingly, in preserving the functionality of the tooth (Petersson *et al*. 1984, European Society of Endodontology 2006)[2]. While assessing technical quality of root canal treatment, three parameters are considered; obturation length, obturation density (homogeneity), and obturation taper. Prior studies to assess quality of root canal on extracted teeth shown 53.3% teeth to have root canal obturation of unacceptable technical quality, 16.2% with slightly acceptable technical quality, 19.3% with acceptable technical quality and 11.2% teeth to have perfectly acceptable technical quality of obturation[3]. Another study revealed acceptability of technical quality of root fillings to be 48%, with 52% being anterior teeth, premolars 49% and 26% molars[2]. Endodontic typodonts are a widely used practice tool at the under graduate level providing a true feel of tooth morphology without need of using extracted teeth which often have morphological aberrations and varied canal anatomy[4]. They provide a standardized unbiased system for each student to train under similar situation[5,6].

Dental students at Fatima Jinnah Dental College learn tooth morphology and endodontic anatomy of both permanent and primary dentition in their First year of BDS in the subject of Oral Biology. This knowledge is utilized to start learning root canal treatment on endodontic typodonts. Assessment of these skills and altering clinical teaching accordingly leads to well-trained dental graduates, who attain a smooth shift from pre-clinical environment to patient care clinics[7,8].

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Current years have seen a noticeable surge in the patient's demand for root canal treatment in line to the increased age of the people, so it is imperative that dental students possess knowledge and skills of this discipline to meet this demand. This guarantees long term patient comfort, aesthetics and prevents reinfection[7]. Overall quality of dental health service in our population will be optimized. Therefore, this study aimed to assess technical quality of root canals performed on endodontic typodonts by pre-clinical students of Fatima Jinnah Dental College.

METHODOLOGY

Study design, Setting and Duration: It was a Cross-Sectional Study performed in the Department of Oral Biology, Fatima Jinnah Dental College and Hospital, Karachi, Pakistan. This study was done over a period of three months, from 01-10-2020 to 01-12-2020.
Sample size Sample size was calculated using Open Epi-Epidemiologic calculator software. According to literature search percentage of unacceptable technical quality of root canal treatment was 53% and percentage of adequate technical quality of root canal treatment was 11%[3]. Keeping confidence level 95% and power 80%, the sample size required was 49.
Data collection method and tools: Anterior and posterior endodontic typodont (Images 1 and 2) were prepared by students by means of stainless steel K files (Dentsply Mailler) with crown down technique. Obturation was done using lateral compaction technique (0.02 taper gutta percha points) Gapadent Co. GmbH and ADSEAL sealer (Meta Biomed Europe GmbH). These canals were then evaluated according to three parameters (obturation length, obturation taper and obturation density) (Table 1). A score was given to each parameter (Table 2). Technical quality of root canal treatment was assessed on the basis of root canal obturation length being short of apex, extending beyond apex or at the apex. Obturation density as having voids, or no voids and obturation taper being sufficient or not. Each parameter was given a score of

0, 1 and 2 in accordance with being unacceptable, acceptable and perfect respectively. Scores from all three parameters were added up to give a total score of 6 and students were given marks in the percentage form on a grading sheet according to these scores (Attachment 1). Inter examiner reliability was checked (Table 2). Kappa statistics came out to be 0.61 which indicated inter examiner reliability of more than 60%, suggesting a substantial agreement between all scores.

Data analysis: Data was evaluated using SPSS software, version 20.0 (SPSS, Inc., Chicago, IL, USA). Descriptive analysis was done separately for each kind of root canal. Chi-square analysis test was used to compare quality of root canal obturation between types of tooth. The tests were performed at a 0.05 significance level. According to Pearson chi square the value between anterior and posterior teeth was 7.87 (p value 0.795). Therefore, p value was greater than 0.05 where we assumed no significant correlation between anterior and posterior teeth in all three-assessment variables.

RESULTS

A total of 20 anterior and 30 posterior endodontic teeth were evaluated according to the assessment variables and their results summarized in (Table 1). Under filled obturation length gave similar percentages in both groups at 7.1%. Nearly 7% difference was found in over filled canals where anterior were more over filled than posterior. Other than that, 92.9% anterior & posteriors were graded as having an adequate length, showing more adequate length control in posterior teeth. Only an extra of 1% severely visible voids were found while measuring density of root canal obturation in posteriors as compared to anterior typodonts. Posterior teeth surged the percentage category of one visible void contrasting anterior. A considerable variation was evaluated in the parameter of adequate density for both groups of teeth where a smaller number of posteriors were more densely filled. Lastly, it was deduced that students had more difficulty creating obturation taper in posterior typodonts where 20% cases were under or over shaped. Anterior typodonts showed more adequate taper when comparing adequacy of obturation taper between the two groups.

Table 1: A comparison of length, density and taper of root canal obturation between anterior and posterior typhodonts

Posterior %				
Length of Root Canal Obturation	**Unacceptable**	**Acceptable**	**Perfect**	**P Value**
0= Unacceptable	0 (0%)	0 (0%)	1 (100%)	0.78
1= Acceptable	0 (0%)	0 (0%)	5 (100%)	
2= Perfect	1 (7.1%)	0 (0%)	13(92.9%)	
Density of root canal obturation				
0= Unacceptable	0 (0%)	1 (100%)	0 (0%)	0.78
1= Acceptable	0 (0%)	7 (77.8%)	2 (22.2%)	
2= Perfect	1 (10%)	6 (60%)	3 (30%)	
Taper of root canal obturation				
0= Unacceptable	0 (0%)	1 (100%)	0 (0%)	0.48
1= Acceptable	2 (20%)	4 (40%)	4 (40%)	
2= Perfect	0 (0%)	4 (44.4%)	5 (55.6%)	

P value <0.005 is considered as significant.

Assessment variables

Length of Root Canal Obturation

0= Root filling ending >2 mm short of the anatomical apex **(under-filling)**. Root filling limited to the pulp chamber.

Root filling ending beyond the anatomical apex **(over-filling)**

1= Root filling ending at the anatomical apex (tip-to tip) or 1-2 mm shorter than the anatomical apex

2= Root filling ending 0.5-1 mm short of the anatomical apex (**adequate)**

Density of Root Canal Obturation

0=Inhomogeneous root canal obturation with several visible voids

1=Root canal obturation with only one visible void

2=No void present in the root canal obturation (adequate)

Taper of Root Canal Obturation

0=Not consistently tapered from the apex to the coronal part (over- or under-shaped)

1=Not enough taper

2=Consistently tapered from the apex to the coronal part (adequate)

Figure 1: The graph shows the scores obtained by the students in anterior and posterior typodont filling

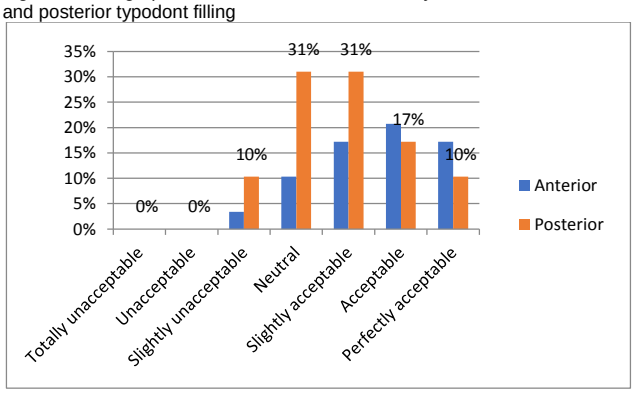

Table 2 Inter examiner reliability Intraclass Correlation Coefficient

Intraclass Correlation[a]		**95% Confidence Interval**		**F Test with True Value 0**			
		Lower Bound	**Upper Bound**	**Value**	**df1**	**df2**	**Sig**
Single Measures	.719[b]	.510	.866	8.692	19	38	.000
Average Measures	.885[c]	.758	.951	8.692	19	38	.000

Parameters used to evaluate root canal obturation

Quality categories of root canal treatment

Evaluation points	Quality of case	Student mark
Cases with 0–2 points	Totally unacceptable	0%
Cases with 3 points with a length score of 0	Unacceptable	20%
Cases with 3–4 points with a length score of 1	Slightly unacceptable	40%
Cases with 3 points with a length score of 1 or 2	Neutral	50%
Cases with 4 points with a length score of 1 or 2	Slightly acceptable	60%
Cases with 5 points	Acceptable	80%
Cases with 6 points	Perfectly Acceptable	100%

Image 1: Anterior typodont

Image 2: Posterior typodont

DISCUSSION

Preclinical exercise on undergraduate students enhances the self-confidence levels and clinical performance of root canal treatment as was discussed by Reem et al in their study [9]. Our study was carried out on 20 anterior and 30 posterior endodontic typodonts for assessment of technical quality of root canal treatment. All procedures were done by undergraduate students of Fatima Jinnah Dental College at preclinical campus under the supervision of demonstrators. These demonstrators marked them on each step from access cavity preparation to obturation. Initially the lecture was delivered by trained and experienced endodontist who spoke of the techniques used as well as the armentarium required. This allowed students at a pre-clinical level to benefit first hand from knowledge of a clinician. A similar approach was followed by faculty at Taibah University in their study[3]. At a pre-clinical level, students were able to design the access cavity of both anterior and posterior typodont teeth using a variety of burs which also reinforced the concepts of tooth morphology taught to them in their oral biology course. Students were also introduced to proper handling of slow and high speed hand pieces and guided in their proper angulation while working on these typodonts. This has previously also been observed in the study by Reem et al[9].

Once all students had completed root canal therapy on the typodonts, experienced endodontists were asked to assess the quality of root canal treatment which resulted in a thorough and in depth analysis of the technical quality of obturation as carried out by James et al in their study[10].The assessment was based on three major variables which were further categorized on a scale of 0,1, and 2 .The first category was to evaluate obturation length whether it is short of the apex, beyond the apex or at the apex .The second category was to determine the obturation density measured by the presence or absence of voids. Whereas the third variable marked the shape of the obturation with respect to the consistency of taper (Appendix 1)[3]. For success of root canal therapy, students were taught to be vigilant in avoiding avoid procedural errors, whilst having essential knowledge of root filling technique to minimize future inconvenience to the patient [11]. Our study showed 10% underfilled root canal obturations for both anterior and posterior typodonts. It has been suggested that this can be due to ledge formation caused by improper cleaning and shaping of canals and debris accumulation[11]. Prior studies showed 69.6% root fillings of adequate length, reported by Ribeiro et.al[2]. In another study, percentage of root canal treatment with sufficient length was 65.5% with NiTi rotary technique and 34.5% in stainless steel hand group which is inferior compared to our study [12]. A higher percentage of adequate length control was seen in posterior typodonts compared to anterior typodont obturations, indicating better ability of the students to file and obturate shorter canals. A result of 15% in anteriors and 6.6% in posteriors was graded as overfilled. This could have been caused by overzealous instrumentation or faulty length control. In comparison to our study, previous studies have used extracted teeth and radiographic imaging to categorize root fillings as acceptable or unacceptable[13]. In another study, 259 extracted teeth were preserved endodontically where 138 (53.3%) had an objectionable root canal quality obturation[3]. Sufficient compactness of root canal filling is a vital factor for long-term accomplishment of endodontic treatment [14]. Higher percentage of root fillings with sufficient density was seen in anterior tyodonts at 45% while 5% and 6% having severe voids was recorded in anterior and posterior typodonts respectively. This could be a lack of proper lateral condensation and excessive use of sealer[15]. In this study, 45% of canals were of sufficient density. This result is greater in comparison to other studies which reported 27.6%–35.5% of canals with adequate density[16]. In contrast to works done by Moussa-Badran et al and other authors[17,18,19], this study showed no substantial association between type of tooth and density of the filling, though to some extent different criteria was used, which makes assessment tough. In addition to this, Khabbaz et al. and various other studies[20,21,22]considered other parameters like procedural errors to determine technical quality of obturation. They did not record any missed canals, but reported apical foramen and root perforation in 11.8% and 32.6% of canals respectively. In a study by Rafeek et al.1.5% cases had fractured instruments [23,24,25].

Certain restrictions to this study should be considered, the use of endodontic typodonts lacked the experience of anatomical aberrations present in the natural root canal system. These are encountered with ease while learning root canal treatments on extracted teeth. Students did not have the need of using radiographs as the endodontic typodonts are transparent which also compromised ability to gain experience of radiographic interpretation in the future while working in the patient's mouth. Many students were even seen trimming excess gutta percha points from the bottom of the typodont when canals were overfilled. The working length was effortlessly determined and artificial teeth gave way with ease under a high-speed hand piece as compared to the natural teeth. These limitation will help us devise better tools for endodontic tooth simulation in the future to train students at pre-clinical level.

CONCLUSION

To conclude, the obtained results showed that the quality of root canal treatment performed by Fatima Jinnah Dental College undergraduate dental students showed better technical quality on anterior endodontic typodonts as compared to posterior endodontic typodonts showing a necessity for practice on extracted teeth especially posterior teeth before being given actual patients.

Ethical approval / disclosure: Institutional Ethical Review Committee of Fatima Jinnah Dental College and Hospital provided the ethical clearance (Ref No: FJDC/OCT-2020-OPR02) after determining that the study was in vitro and posed no harm to students.

Authors' contribution: RR was the primary author who collected the data and wrote the manuscript. **MBB** did the interpretation and analysis. **MB** helped in selecting the topic and re-analyzed the data for inter-examiner reliability. **ZA:** contributed in write-up and final revision of the manuscript. **HA** contributed reviewed the final write up. **GA** helped in literature search.

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